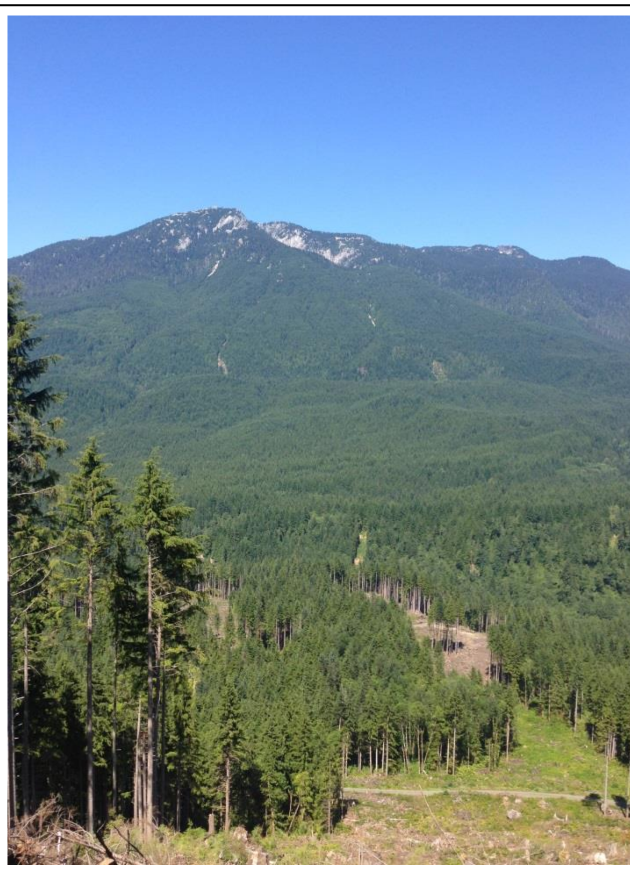
N A T U R A L R E S O U R C E S

SUPPLEMENTAL INFORMATION:

State Trust Lands Habitat Conservation Plan Implementation Monitoring:

Implementation of management activities in wetland management zones and hardwood-dominated riparian management zones



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Forest Resources Division,
Washington State Department of
Natural Resources

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

Wetland and WMZ monitoring

Methods

Activity screening

We found wetlands ≥ 0.25 acres where harvest and/or road construction had occurred by finding FMUs encompassing these activities. We found these by first querying DNR's Forest Management Planning and Tracking database (P&T) to find FMUs with "wetland" as an objective category. We then queried a Geographic Information System (GIS) layer, which is compiled from P&T data, for FMUs with names that included "WMZ," or "WET." Once we identified these units, we reviewed the prescriptions in P&T to verify that activities were planned in each unit. We retained all FMUs that were part of timber sales listed as "closed" in NaturE, DNR's revenue tracking database, during fiscal year 2013 (July 1, 2012 – June 30, 2013). We dropped any FMU located in eastern Washington or the Olympic Experimental State Forest since we were interested only in activities that implemented the wetland component of the Riparian Conservation Strategy for the Five Westside Planning Units[1]. Two additional units were found while conducting field reviews. These units had been identified in P&T as riparian management zones, but we considered them to be WMZs because they were adjacent to wetlands > 1 acre in size, and outside the 100-year floodplain of a Type 3 stream. In total, we reviewed 16 forest management units (FMUs) around 15 wetlands/wetland complexes on 14 timber sales.

Data collection

Wetland edge identification and area measurement

First, we identified the wetland edge since all other measurements were based off of this location. This was accomplished using the methods that DNR foresters are trained to use in the field and which are derived from guidance provided in the Forest Practices Board Manual from 1995 and the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Western Mountains Valleys and Coast Region (U.S. Army Corps of Engineers 2010). In training, foresters are instructed to identify and delineate wetlands by assessing three ecological parameters, including:

a) hydrophytic vegetation – vegetation that requires, or is tolerant of, prolonged inundation or soil saturation during the growing season

[1] This strategy applies to all western Washington planning units expect the Olympic Experimental State Forest Planning Unit.

b) hydric soils – soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part

c) wetland hydrology – saturation within one foot of the soil surface for two weeks or more during the growing season in most years

As field indicators for one or more criteria may be seasonally difficult to discern, professional judgment (of foresters, specialists and monitors) is used when necessary.

These parameters were assessed with respect to the 1995 Forest Practices wetland definition, which is used by DNR on state lands. The definition states:

> 'Wetland' means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, such as swamps, bogs, fens, and similar areas. This includes wetlands cleared, restored, or enhanced as part of a mitigation procedure. This does not include constructed wetlands or the following surface waters of the state intentionally constructed from wetland sites: irrigation and drainage ditches, grass-lined swales, canals, agricultural detention facilities, farm ponds and landscape amenities.'

Upon reaching a wetland, we first determined the wetland edge by evaluating vegetation, hydrologic and soil indicators (See Appendix 1b: Wetland indicators). For the vegetation indicators, we did not establish formal plots but instead selected a circular area 11.78 feet or less in radius ($1/100^{th}$ acre or less) in which to estimate vegetation coverage. The size of the circular area depended on vegetation conditions. In order to determine wetland hydrology, we looked for primary and secondary indicators (See the Wetland Indicators section below). Wetland hydrology is indicated by one primary or two secondary indicators. Soil indicators were evaluated based on surface and underground soil conditions. We typically dug three soil pits at each wetland to assess the soil profile. We dug one pit in an area with pronounced wetland vegetation and hydrologic indicators and one pit in an upland area. We dug the third pit in an area where the vegetation and hydrologic indicators transitioned from wetland to upland. Once the edge was determined, we used this point to understand the 'signature' of the wetland edge which helped us determine the wetland edge at subsequent measurement points (henceforth, called stations). At each station, we recorded one or more of the indicators that we used to identify the wetland edge. These stations were also used as the base for measuring WMZ width and locating basal area plots.

We estimated the size of the wetland visually in the field and occasionally in GIS as well. If the wetland was close in size to the HCP thresholds where required protection changes (i.e. 0.25 and 1.0 acres), we collected GPS points along the wetland edge and measured the area in GIS. Each GPS point was compiled from the average of at least 20 location estimates. We used a Garmin 60CS or Garmin 62S GPS unit for all GPS data collection.

Basal area measurements

Since the basal area requirement applies to the entire WMZ, not just the managed area (the wetland side of which was delineated by timber sale boundary tags), we collected basal area data using plots placed systematically throughout the entire lateral extent of WMZs where management activities occurred. The measurement area was bounded on the wetland side by the wetland edge. The outside edge of the WMZ was defined as the requisite width, which depended on the size of the wetland. We defined the lateral extent of the measurement area as the area between the intersections of the managed area (defined by timber sale tags) and the WMZ. The lateral boundary of the measurement area was a line perpendicular to the tangent of the wetland edge extending to the edge of the WMZ.

For wetlands ≥ 0.25 and ≤ 1 acre, this meant that we took the first measurements where the timber sale boundary tag line surrounding an area where wetland thinning is prescribed first comes within 100 feet of the wetland edge. For wetlands > 1 acre in size, measurements began where the tags come within a distance equal to the 100-year site index of the upland stand. Unthinned skips and voids within the managed area counted toward the basal area. Trees between the managed area and the wetland also counted toward the basal area. However, trees outside the managed area laterally did not count toward the basal area.

We used a basal area factor (BAF) 20 prism to collect basal area data. Only live trees were counted[2]. We recoded the species of each tree counted.

We placed plots in the WMZ surrounding wetlands systematically with a randomized start location, if space allowed. We randomized the location of the first plot parallel to the edge of the wetland between 50 and 75 feet from the shortest line between the wetland edge and the edge of the WMZ that defines that lateral edge of the managed WMZ. Random numbers were generated by a smart phone application. In the 100-foot WMZ around wetlands ≥ 0.25 and ≤ 1 acre in area, all plots were located 50 feet from the edge of the wetland. In 100-year site index WMZs, the plot alternated between 50 feet from the wetland edge and the 100-year site index minus 50 feet from the wetland edge.

We spaced plots parallel to the wetland edge based on the length of the wetland edge (Table 1; Figs. 1 and 2). If a WMZ was managed with more than one FMU, we summed the lengths of the wetland edge adjacent to each unit to determine plot spacing.

In all managed wetland areas, a minimum of three plots were measured, if space allowed. If three plots could not be placed randomly in a management area, we systematically placed the plots to fit. In very small management units we found basal area by measuring diameter at breast height

[2] This basal area requirement of the Riparian Conservation Strategy for the Five Westside Planning is intended to retain a tree canopy that is sufficient to maintain the hydrologic characteristics of the wetland. As only live trees transpire, the basal area requirement only applies to live trees.

of all trees. We also did this in one WMZ as it was clear that the three randomly placed plots did not adequately capture the basal area of the WMZ. In addition, post-harvest windthrown trees were also measured to determine the basal area immediately following the harvest.

When management occurred in the entire WMZ completely encircling the wetland, we placed the first plot 50 to 75 feet parallel to the wetland edge from an arbitrary point where we happened to be standing. We determined the location of the plot clockwise or counter-clockwise from the arbitrary point based on the direction we had travelled to reach the point. If we reached the point following a generally clockwise path, the plot was located clockwise from the arbitrary point, and vice versa.

In areas where a harvested WMZ surrounded two or more wetlands, no plots were put between wetlands areas closer together than 100 feet so as to keep plots least 50 feet from any wetland. If wetlands were more than 100 feet apart, plots were placed around each wetland such that they did not overlap.

Some plots were dropped because of overlap with other plots. Plot overlap was due to sinuous wetland edges or multiple wetlands in a complex. In these cases, an alternate plot center was placed 50 feet in the direction of travel parallel to the wetland edge. If this location was unacceptable, the plot was dropped. Data collection resumed at the next scheduled plot.

Table 1. Distance between basal area plots.

Length of wetland edge	Distance between plots	Expected number of plots
0 to 2000 feet	100 feet	3* to 20
2000 to 4000 feet	200 feet	10 to 20

* A minimum of three plots were taken in each WMZ. Where three plots could not be placed without overlap all trees in the WMZ were measured.

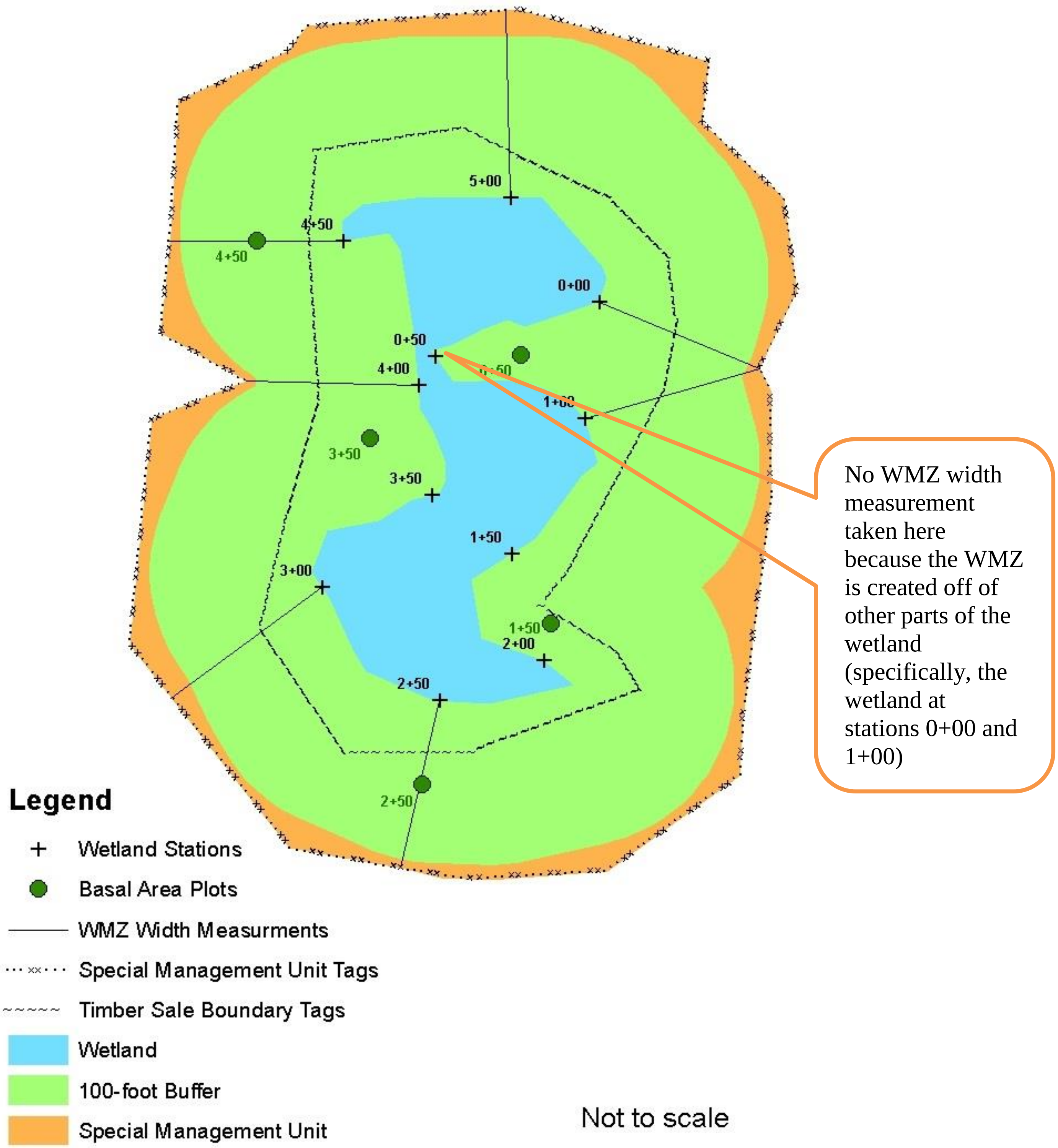

Figure 1. Diagram of WMZ width measurements and basal area plot locations when harvest occurs on all sides of a wetland. Note: width is measured along the shortest line between the wetland edge and the edge of the special management unit while basal area plots are located perpendicular to the wetland edge.

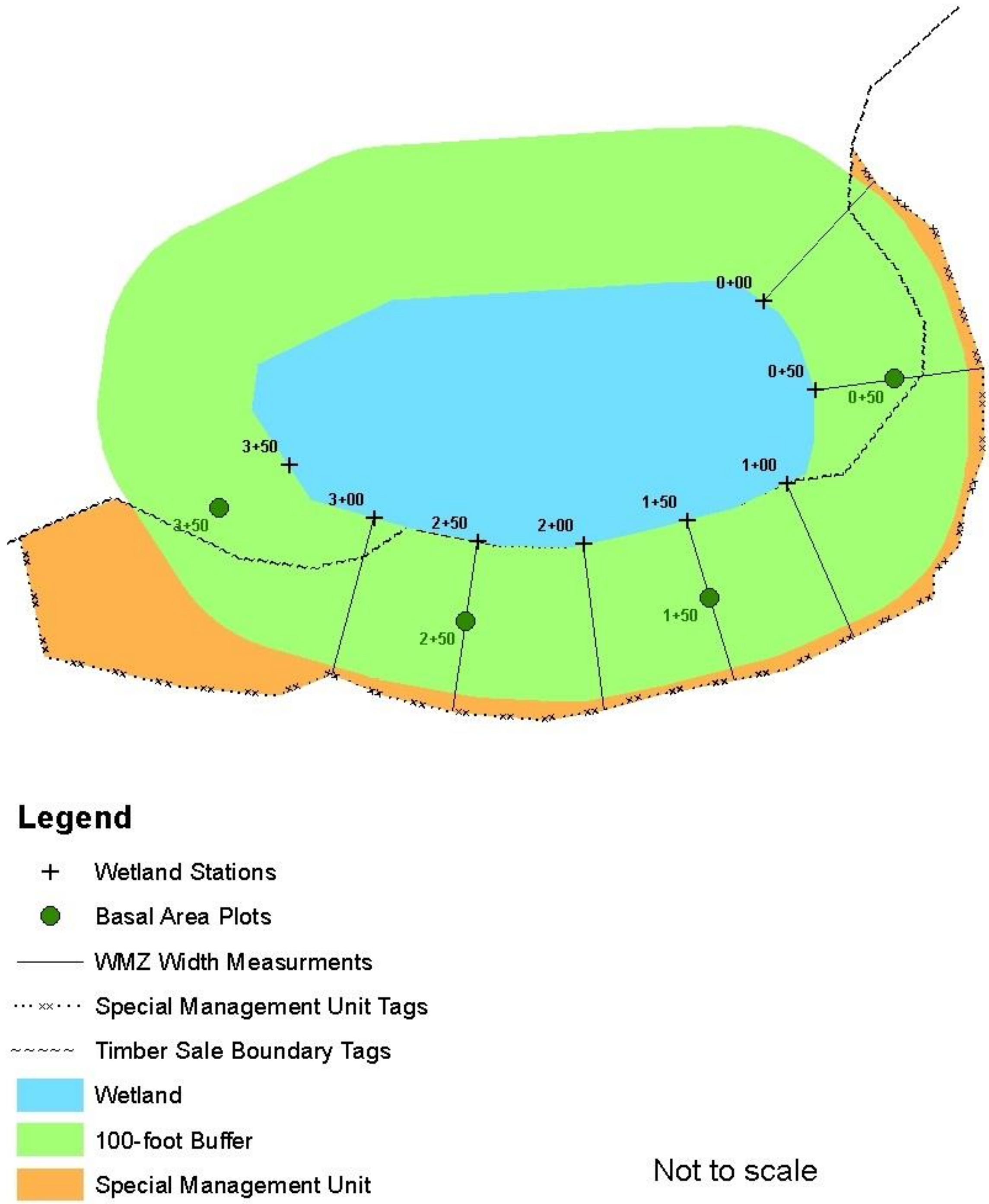

Figure 2. Diagram of WMZ width measurements and basal area plot locations when harvest occurs on one side of a wetland. Note: width is measured along the shortest line between the wetland edge and the edge of the special management unit while basal area plots are located perpendicular to the wetland edge.

WMZ width

Where management in WMZs was adjacent to upland regeneration harvests, we measured the distance from the outside edge of the wetland to the first stump beyond the Special Management Unit tags used to define the WMZ at 50-foot intervals. We made measurements along the shortest line between the wetland edge and the upland harvest edge. We did not take measurements in places where the edge of the WMZ was closer to other parts of the wetland than to the measurement point.

We measured horizontal distance to the nearest foot with a laser range finder and/or a metal tape. The rangefinders used were the Laser Technology TruPulse 360R (accuracy rating ± 1.0 foot) and Laser Technology Impulse 200 LR (accuracy rating ± 0.1 foot).

Exceptional situations

Wetland complexes and small harvest units around convex portions of wetlands were two exceptional cases that required different plotting schemes or additional plots. In wetland complexes it was necessary to put basal area plots between the wetland in areas where WMZ width measurements were not applicable. Basal area plots in these areas were spaced the same distance apart as the plots in the WMZ.

In small harvest units around convex wetland areas, the typical spacing of WMZ width measurements and basal area plots was too wide, resulting in under-sampling of the spatial extent of the WMZ or too few measurements. In these areas, WMZ width measurements were taken every 50 feet as measured from the upland side of the WMZ. Spacing of wetland plots was based the upland side of the WMZ as well.

Consultation letter monitoring

Two FMUs visited had consultation letters for salvage operations allowed under the HCP. We evaluated these FMUs based on the requirements in the concurrence letters.

Machine use near non-forested wetlands

We monitored rutting consistent with language in clauses H-017 of the timber sale contract that covered each harvest activity. This was done by visually estimating the area of ruts within skid trails within the WMZ. In addition, we visually estimated the area of ground-based equipment tracks within 50 feet of the edge of non-forested wetlands based on recommendations for management in Managing Wetlands (DNR 2000).

Road construction in WMZs

We looked for new road construction within WMZs. In sales where road construction took place, we verified the presence of mitigation features.

Data collection period

Data were collected between July 3, 2013, and July 31, 2013.

Analysis

We entered data from field datasheets into Excel. We calculated descriptive statistics using Excel. Data from separate managed areas adjacent to the same wetland or wetland complex (i.e., part of the same WMZ) were pooled for analysis.

For tests of WMZ width, the null hypothesis was that the width was equal to or wider than the reported 100-year site index for the adjacent upland stand. The alternate hypothesis was that the WMZ was narrower than this.

Because multiple t-tests were run, the false discovery rate was controlled. The false discovery rate is the proportion of results for which the null hypothesis is rejected when it should be accepted out of the total number of results for which the null hypothesis is rejected. This rate was controlled for by using the Benjamini-Hochberg procedure (McDonald 2009). In this procedure each result is ranked by p-value from lowest to highest. Then the p-values are compared to $(i/m)*Q$, where i is the p-value rank, m is the total number of tests, and Q is the desired false discovery rate. If p is less than $(i/m)*Q$ the result is significant, meaning the null hypothesis is rejected. If p is greater than $(i/m)*Q$ the null hypothesis is accepted. The lower the value of Q the less likely the null hypothesis will be rejected due to chance.

For this project, a range of Q values were used. The values used were 0.05, 0.1, and 0.2. We used a range of values because we were uncertain of the appropriate threshold to use. We also hope that by using a range of values trends can be identified over time.

Wetland indicators

The wetland indicators below come from "cheat sheets" on the Westside Wetlands SharePoint page. Also see Regional Supplement to US Army Corps of Engineers Wetland Delineation Manual for Western Mountains, Valleys and Coast Region for additional information.

Hydrology indicators

Primary (you need one primary indicator to satisfy criterion):

- Observation of surface water
- Observation of high water table (12" or less below surface)
- Saturation within 12"(with associated water table immediately below saturated zone OR restrictive layer within 12" of surface)
- Watermarks
- Sediment deposits
- Drift deposits
- Algal mat or crust
- Iron deposits
- Soil surface cracks
- Inundation visible on aerial photographs from growing season
- Sparsely vegetated concave surface
- Salt crusts
- Aquatic invertebrates
- Water-stained leaves (secondary along Coast)
- Hydrogen sulfide odor
- Oxidized rhizospheres along the channels of living roots, within 12" of soil surface
- Presence of reduced iron in upper 12" of surface (changes color when exposed to air)
- Recent iron reduction in tilled soils
- Stunted or stressed plants

Secondary (you need two secondary indicators to satisfy criterion):

- Drainage patterns (evidence of recent flow)
- Dry season water table (between 12" and 24" of the surface)
- Saturation visible on aerial imagery
- Geomorphic position (concave area, toe slope, floodplain, depression, swale, drainage-way, low fringe of water body, extensive flat, area where groundwater discharges)
- Shallow aquitard (within 24" of surface)
- FAC Neutral test (drop all FAC veg from assessment. More than 50% of the dominant vegetation is FACW or OBL)

- Raised ant mounds
- Frost heave hummocks

Wetland Plants (hydrophytes)

Indicator Status:
Obligate (OBL): Found in wetlands more than 99% of the time
Facultative wetland (FACW): Usually found in wetlands (67 to 99% of the time)
Facultative (FAC): Equally likely in wetlands and non-wetlands (34 to 66% of the time)
Facultative upland (FACU): Usually in uplands, but can be in wetlands (1 to 33% of the time)
Obligate upland (UPL): Found in uplands more than 99% of the time

Assess vegetation in each of the following strata:

1) TREES (all woody veg. 3"DBH and larger)
2) SAPLINGS/SHRUBS (all woody veg. <3" DBH)
3) HERBS (all non-woody plants)
4) WOODY VINES

Data needed to identify dominants:

1) List all species within each stratum, and identify coverage and indicator value.
2) Rank each species within strata by coverage.
3) Add coverage of each species within each stratum, beginning with highest coverage, until you immediately exceed 50%. These species (plus any species with 20% or more coverage) are dominants*.

Vegetation Indicators:

- Rapid test: All dominant species across all strata are OBL, FACW, or a combination of the two
- Dominance test: More than 50% of the dominants across all strata are OBL, FAW, or FAC ("50-20 rule")
- Prevalence index of 3 or less
- Morphological adaptations (buttressed roots, adventitious roots, tussocks, multiple stems) on FACU plants, that, if counted as hydrophytes, would raise the hydrophytic dominance to satisfy rapid test, 50-20 rule or prevalence index.
- Wetland non-vascular plants: More than 50% of the total cover of bryophytes consists of species that are known to be associated with wetlands. (NOTE: If the site has mineral soil, ask for help from a specialist!).

Hydric soils

Hydric soils may have some combination of the following characteristics:

- Organic muck (usually very dark in color, smooth, not gritty), throughout profile or on the surface of a mineral soil
- Peat (an organic soil in which the decomposing plant matter is still visible/identifiable, such as sphagnum peat or woody peat)
- A thick dark mineral surface layer, in which the colors of the soil minerals are masked by decomposed organic matter.
- Colors: grey, greenish, bluish, or pale brown to beige
- Reddish, yellowish or rusty-looking spots or mottles (redoximorphic features)
- Pale grey or beige areas or spots (depletions)
- Rusty-looking halos around the channels of live roots
- Hydrogen sulfide odor (smells like rotten eggs)
- Black nodules or concretions

If you are not sure if the soil is an upland soil or a hydric soil, get specialist help.